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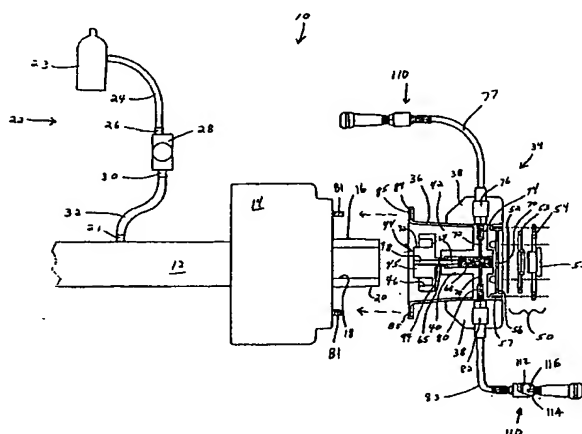
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(54) Title: ON-AXLE TIRE INFLATION SYSTEM



(57) Abstract: A tire inflation system utilizes compressed air directed through the axle (12), a rotary union seal oil/bearing cap, and a rim assembly (34) which allows the tire(s) to be inflated while mounted to the axle. The rim (36) of the rim assembly is mounted to the rotor of the axle and includes integral air bores for distributing incoming compressed air to tire inflation lines for both the inner and outer tires of a dual tire rim of a tractor-trailer. Compressed air, preferably from an on-board reservoir, flows through a regulator, and into a bore (18) in the axle. The axle bore (18) is in communication with a rotary union seal or bearing cap threadedly coupled to the end of the axle. The bearing cap includes a bore that is in fluid communication with the axle bore and the integral air bores of the rim. The integral air bores of the rim terminate in quick connects (76, 82) to which are coupled tire air distribution lines.

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ON-AXLE TIRE INFLATION SYSTEMBACKGROUND OF THE INVENTION

1. Field of the invention.

5 The present invention relates to on-axle tire inflation systems and, more particularly, to an on-axle tire inflation system utilizing an axle and rim assembly air distribution system.

2. Description of the related art.

10 One problem associated with pneumatic tires especially in tractor-trailer systems involves maintaining proper or appropriate air pressure. A low pressure situation in a tire can often go undetected for a long period of time. While it is prudent to periodically check tire inflation pressure with an air pressure gauge, such checks are sporadic at best. A low pressure
15 tire can cause many problems. As well, a high pressure tire can also cause problems.

The concept of providing an on-axle tire inflation system, or what is known as a central tire inflation system (CTIS) or automatic tire inflation system (ATIS), is well known in the art.
20 Such systems remotely or automatically inflate a pneumatic tire rotatably mounted onto the axle of a vehicle via an air distribution system. Typically, an on-board source of pressurized air such as compressed air from the vehicle air brake compressor and/or compressed air reservoir, is used to fill the
25 tire. In this manner, the pneumatic tire may be inflated without

the need to remove the tire from the axle. Some systems may also provide for the deflation of the tire or air pressure monitoring.

Such on-axle tire inflation systems have been incorporated into many types of vehicles such as tractor-trailers and off-road vehicles. By incorporating such systems into the vehicle, tire pressure associated problems may be alleviated.

However, such prior art systems are generally complicated and/or cumbersome. Additionally, in the case of truck trailers, most truck trailers are provided with a lubrication compartment at the end of the axle for containing lubricant for the wheel bearings. Such systems may include an oil sight glass and an oil plug for filling and inspecting the lubricant level in the lubrication compartment. A tire inflation system must therefore also incorporate or accommodate such a lubrication system.

SUMMARY OF THE INVENTION

In one form, the present invention is a tire inflation system for inflating a pneumatic tire mounted onto a tire rim that is coupled to an axle.

In an embodiment thereof, the present invention is a tire inflation system for a vehicle having pneumatic tires mounted onto a hollow axle having threads at an end thereof and a rotor mounted on the axle for rotation therewith. The tire inflation system includes a source of compressed air, a supply air system, a bearing cap, and a rim assembly. The supply air system is coupled to the source of compressed air and the axle, and provides fluid communication between the source of compressed air and the hollow of the axle. The bearing cap has threads on one

end thereof and is threadedly coupled with the axle threads.
Further, the bearing cap includes a bearing cap bore
therethrough. The rim assembly is mounted to the rotor and is
adapted to carry the tire. The rim assembly includes a hub
5 portion having a hub bore therein with the bearing cap situated
such that the bearing cap bore is in fluid communication with the
hub bore. The hub portion includes first and second radial
spokes, the first radial spoke having a first radial bore in
fluid communication on one end with the said hub bore and a first
10 quick connect at another end, the second radial spoke having a
second radial bore therein in fluid communication on one end with
said hub bore and a second quick connect at another end.

In this manner, compressed air is delivered to the pneumatic
tires of a vehicle via an on-board air reservoir while the
15 pneumatic tires are mounted on the axle.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of
this invention, and the manner of attaining them, will become
more apparent and the invention will be better understood by
20 reference to the following description of embodiments of the
invention taken in conjunction with the accompanying drawings,
wherein:

Fig. 1 is a front plan view of one side of an axle and a
sectional view of a rim assembly that is mountable with respect
25 to the axle in accordance with the principles of the present
invention;

Fig. 2 is a sectional view of the rim of Fig. 1;

Fig. 3 is a front view of the rim of Fig. 2;

Fig. 4 is a rear view of the rim of Fig. 2;

Fig. 5 is an enlarged, side sectional view of the bearing cap of the rim assembly of Fig. 1;

5 Fig. 6 is a front view of the bearing cap of Fig. 5; and

Fig. 7 is a rear view of the bearing cap of Fig. 5.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplification set out herein illustrate a preferred embodiment of the invention, in one
10 form, and such exemplification is not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings and more particularly to Fig. 1, there is shown one side of a vehicle axle, generally
15 designated 12, having a rotor 14 or the like fixedly mounted thereon and internal bore or hollow 18. Threads, indicated at 20, are also provided at end 16 of axle 14. Axle 14 is a depiction of one end of a conventional axle of the type typically provided on trailers of tractor-trailer rigs (not shown).
20 However, it should be appreciated that the present invention is not limited to tractor-trailers, but may be applied to any axle/pneumatic tire vehicle.

Coupled to axle 12 via fitting 21 is air supply system 22 that provides pressurized air from a remote air tank or reservoir
25 23 to bore 18 of axle 12. Tank 23 represents an on-board source of pressurized air such as compressed air from the vehicle air brake compressor and/or compressed air reservoir. However, it

should be understood that the source of pressurized air is not limited to these examples, and could be any type of on-board compressed air source or external compressed air source with the appropriate coupling interface. Air supply system 22 includes
5 incoming air supply line or conduit 24 which is in fluid communication with remote air tank or reservoir 23 or other source of pressurized air. Incoming air supply line 24 is coupled to the inlet of on/off valve 26 such as a ball valve which is in turn coupled to the inlet of air regulator 28.

10 Air regulator 28 is adjustable either manually or automatically to provide air at a regulated pressure. At the outlet of air regulator 28 is air control orifice 30 that is coupled to axle air line 32 which is in turn coupled to fitting 21 affixed to axle 12. Thus, incoming pressurized air is
15 directed through line 24, into air regulator 28, and then into bore 18 of axle 12 via line 32 at a pressure determined by air regulator 28 and air control orifice 30 and suitable for inflation pressure of a pneumatic tire.

Mounted to axle 12 and rotor 14 is rim assembly 34 which
20 carries at least one (1) pneumatic tire (not shown) and preferably two (2) pneumatic tires (not shown) mounted thereon in a conventional side-by-side manner as is typical in tractor-trailer rigs. Rim assembly 34 generally includes rim body 36, bearing or rotary union seal cap 44, and lubrication
25 retention/seal assembly 50. Retention/seal assembly 50 includes gasket 52, sight glass 53, retainer ring 54, and plug 55 which together provide sealing for lubrication within rim body 36 and a

visual inspection of the lubrication level therein. Gasket 52 is generally annular in shape and rests upon annular surface or ledge 56 of rim body 36. Disposed over gasket 52 is sight glass 53 for allowing visual inspection of the lubrication level.

5 Retainer ring 54 is disposed over sight glass 53 and is secured to rim body 36 via screws (not shown) that are received in threaded bores 57. Retainer ring 54 also holds plug 55.

Referring now to Figs. 2-4 rim body 36 is depicted. Rim body 36 is generally tubular-shaped with a center or central hub portion 40 having a first radial spoke 58, a second radial spoke 59, an elongated projection 60 extending along an axial direction relative first and second spokes 58 and 59, and a short projection 61 extending along an axial direction relative first and second spokes 58 and 59 opposite elongated projection 60.

10 Rim body 36 along with center hub portion 40 defines internal cavity 42 that is open at one end. Rim body 36 additionally includes four radially outwardly projecting fins 38 for aiding in the retention of the tires (not shown).

15 Elongated projection 60 has internal bore 64 with graphite 63 that retains O-ring 66 and washer 67. Positioned within internal bore 64 is spring 68 that abuts washer 67 and is retained on one end by NPT plug 70, preferably being a 3/8 NPT plug. Disposed at the end of projection 60 is a square knob 65. Extending through first spoke 58 and in communication at one end

20 with bore 64 is first spoke bore 72.

25 At the other end of first spoke bore 72 is a first air filter 74 and first quick connect 76. Extending through second

spoke 59 and in communication at one end with bore 64 is second spoke bore 78. At the other end of second spoke bore 78 is a second air filter 80 and second quick connect 82. Thus, there is fluid communication between cavity 42 and first and second quick connects 76 and 82. Additionally, rim body 36 includes a peripheral, radially extending skirt 84 having a plurality of mounting bores 85. Screws or the like (not shown) are used to attach rim body 36 to rotor 14 via mounting bores 85.

As depicted in Fig.1, bearing or union seal cap 44 is disposed adjacent knob 65 and thus bore 64. Referring now to Figs. 5-7 bearing or union seal cap 44 is depicted. Bearing cap 44, preferably made of a suitable metal, is defined by bearing cap body 45 of an octagonal shape. Bearing cap body 45 has center hub 88 having bore 90 therethrough and outer portion 96 that radially surrounds center hub 88. Threads 98 are disposed on an inner wall of outer portion 96 which are sized to correspond to threads 20 of axle 12. Circumferential groove 93 is disposed in an outer surface of center hub 88 which holds O-ring 92. Bearing cap body 45 further includes knob 94 on rear surface 95 through which bore 90 extends.

With reference again to Fig. 1, the manner of connection and operation of the present invention will be hereafter described. Rim body 36 is mounted to rotor 14 via studs, bolts or screws through bores 85 in peripheral skirt 84. Preferably, rim body 36 is mounted to rotor 14 via studs 81 and through bores 85 have a tapered contour to allow easy aligning and attachment therebetween. At the same time, bearing cap 44 is threadedly

received onto axle end 16 such that center hub 45 is received into bore 18 of axle 12. O-ring 92 provides sealing when center hub 45 is received into bore 18. When rim body 36 is mounted to rotor 14 and bearing cap 44 is threadedly received onto axle end 16 bore 48 of bearing cap 44 is in fluid communication with bore 18 of axle 12. Additionally, knob 94 of bearing cap 44 abuts knob 65 such that bore 48 is in fluid communication with bore 64. Thus, compressed air from tank 23 flows through line 24, into pressure regulator 28, through line 32 and into axle bore 18. The compressed air then travels into bores 48 and 64, into spoke bores 72 and 78, through air filters 74 and 80 then quick connects 76 and 82 respectively. Coupled to quick connect 74 is air conduit 77 that feeds an inner tire (not shown) of the twin tire pair such as on a tractor-trailer by connection to the valve stem (not shown) of the tire. Coupled to quick connect 82 is air conduit 83 that feeds an outer tire (not shown) of the twin tire pair such as on a tractor-trailer again by connection to the valve stem (not shown) of the tire. Since air conduits 77 and 83 are coupled to the valve stems of the mounted tires, constant air pressure may be maintained within the tires without the need for periodic checking. Of course, the principles of the present invention may be utilized for a single tire of a single rim system, or may be adapted for multiple tires.

More particularly, air conduits 77 and 83 are each connected to a quick connect assembly 110 (the quick connect assembly 110 connected with air conduit 83 being shown partially fragmented for illustration). Each quick connect assembly 110 includes

5 mating male and female connectors, similar to conventional
pneumatic fittings. However, each quick connect assembly also
includes a one-way check valve 112 which only allows air to flow
toward the tire. Thus, if the air pressure within the tire
becomes low, the pressure differential allows higher pressure air
to flow into the tire. Moreover, each quick connect assembly can
be disconnected from the tire without losing pressure from within
air conduit 77 or 83. Each quick connect assembly also includes
a female threaded portion 114 which screws directly onto a valve
10 stem of the tire, and a projection 116 which holds the valve
within the valve stem in an open position.

15 While this invention has been described as having a
preferred design, the present invention can be further modified
within the spirit and scope of this disclosure. This application
is therefore intended to cover any variations, uses, or
adaptations of the invention using its general principles.
Further, this application is intended to cover such departures
from the present disclosure as come within known or customary
practice in the art to which this invention pertains and which
20 fall within the limits of the appended claims.

WE CLAIM:

1. A tire inflation system for a vehicle having pneumatic tires mounted onto a hollow axle and a rotor mounted on the axle for rotation therewith, the tire inflation system comprising:
 - a source of compressed air;
 - an air supply system coupled between said source of compressed air and the hollow axle; and
 - a rim assembly having a housing adapted to securely mount to the hollow axle proximate the rotor, said rim assembly including first and second structures, said first structure having a first opening therein and in fluid communication with said hollow axle, second structure being rotatable with respect to said first structure and having a second opening therein in fluid communication with said first opening, said rim assembly housing biasing said second structure against said first structure.
2. The tire inflation system as specified in Claim 1 further comprising a spring biasing said second structure against said first structure.
3. The tire inflation system as specified in Claim 2 wherein said spring resides in said second structure second opening.
4. The tire inflation system as specified in Claim 3 wherein said spring leverages against said housing.
5. The tire inflation system as specified in Claim 1 wherein one of said first structure or said second structure has a knob engaging said other structure.

6. The tire inflation system as specified in Claim 5 where each said first structure and said second structure have a respective knob engaging one another.
7. The tire inflation system as specified in Claim 5 wherein said knob is comprised of graphite.
8. The tire inflation system as specified in Claim 1 wherein said first structure has a portion adapted to be sealingly and securely received within said hollow axle.
9. The tire inflation system as specified in Claim 1 wherein said hollow axle has a first threaded portion, and said first structure has a second threaded portion adapted to threadably engage said hollow axle first portion.
10. The tire inflation system as specified in Claim 9 further comprising an o-ring disposed about said first structure portion and adapted to seal against and within said hollow axle.
11. The tire inflation system as specified in Claim 1 further comprising a first quick connect structure fluidly coupled to said second structure second opening.
12. The tire inflation system as specified in Claim 11 further comprising a second quick connect structure fluidly coupled to said second structure second opening.
13. The tire inflation system as specified in Claim 1 further comprising an air regulator coupled to said air supply system.

14. The tire inflation system as specified in Claim 1 wherein the rim assembly housing has structure adapted to secure to the rotor.

15. The tire inflation system as specified in Claim 1 wherein said first opening is fluidly sealed to said second opening.

16. The tire inflation system as specified in Claim 1 wherein said first structure and said second structure each have a surface abutting one another about an interface of said first opening and said second opening.

17. A tire inflation system for a vehicle having pneumatic tires mounted onto a hollow axle and a rotor mounted on the axle for rotation therewith, the tire inflation system comprising:

a rim assembly having a housing adapted to securely mount to the hollow axle proximate the rotor, said rim assembly including first and second structures, said first structure having a first opening therein and adapted to fluidly communicate with said hollow axle, second structure being rotatable with respect to said first structure and having a second opening therein in fluid communication with said first opening, said rim assembly housing biasing said second structure against said first structure.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/18277

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B60C23/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B60C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 584 949 A (INGRAM ANTHONY L) 17 December 1996 (1996-12-17) column 2, line 48 -column 4, line 58; figures 1-10	1,17
A	US 5 377 736 A (STECH CLYDE G) 3 January 1995 (1995-01-03) column 2, line 26 -column 4, line 22; figures 1-5	1,17

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search

26 September 2000

Date of mailing of the international search report

06/10/2000

Name and mailing address of the ISA

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5584949 A	17-12-1996	AU 4914296 A WO 9624498 A	27-08-1996 15-08-1996
US 5377736 A	03-01-1995	NONE	

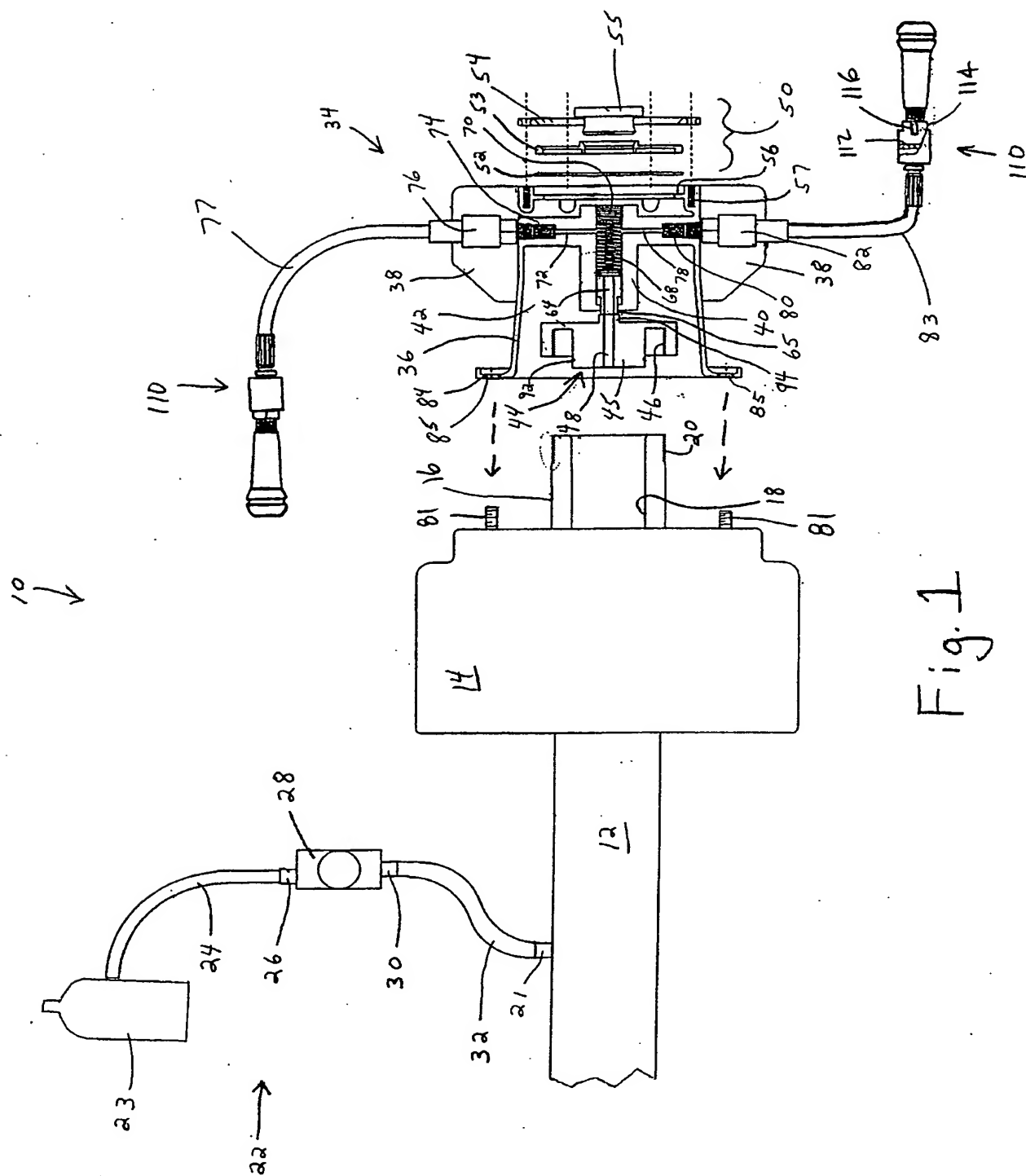


Fig. 1

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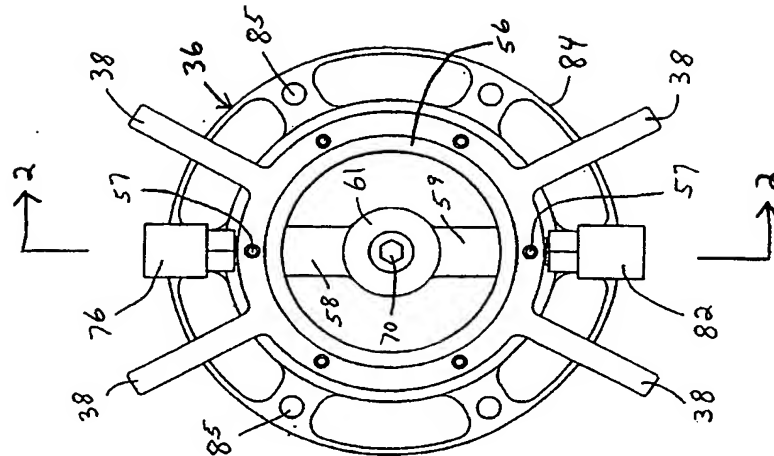


Fig. 3

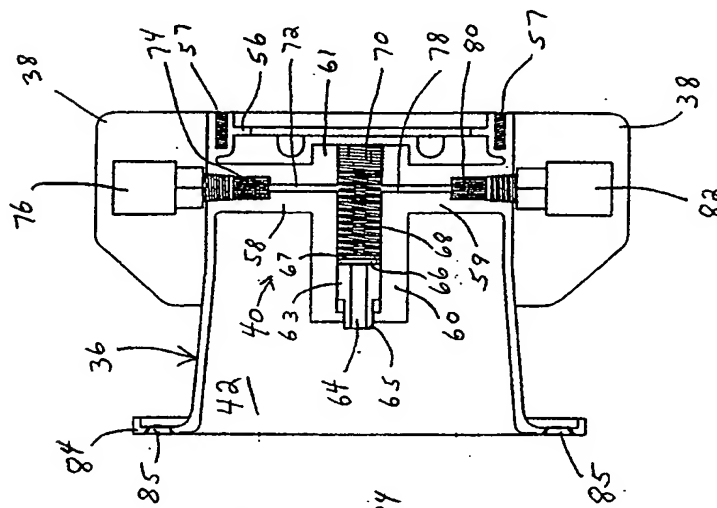


Fig. 2

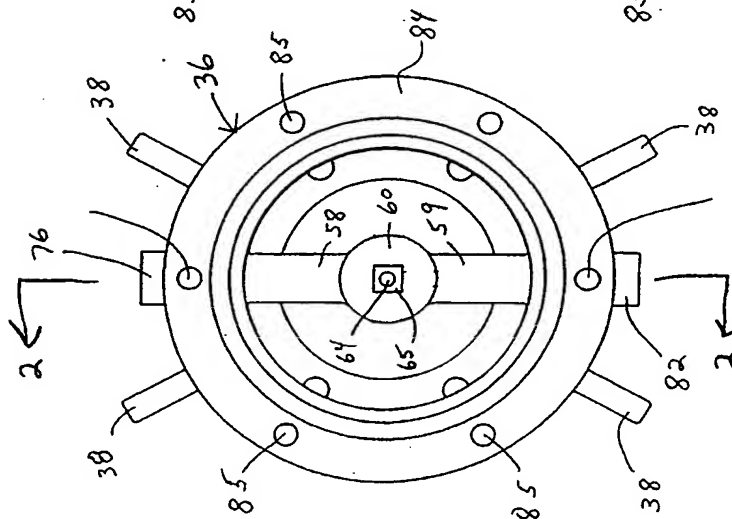
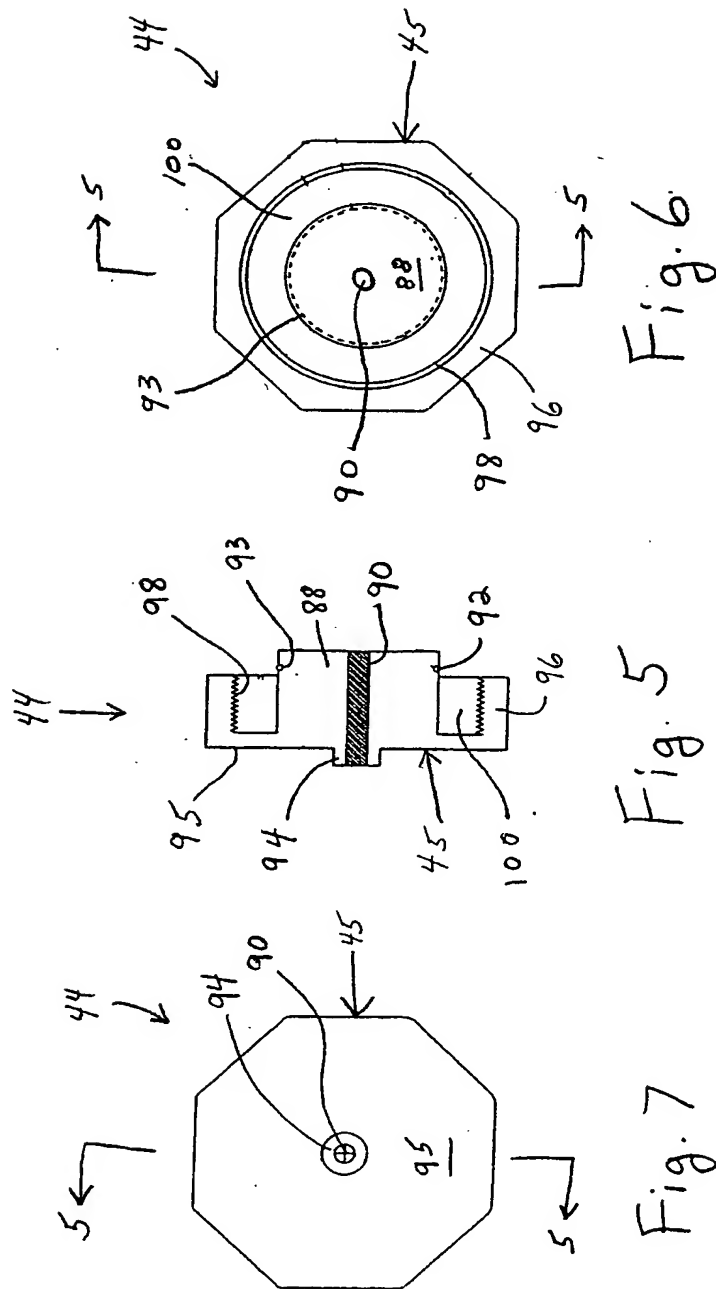


Fig. 4



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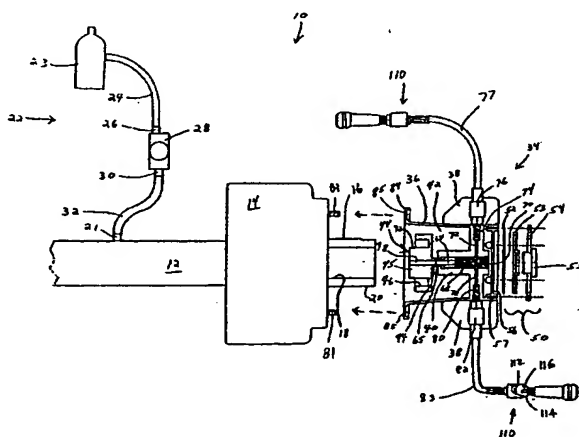
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

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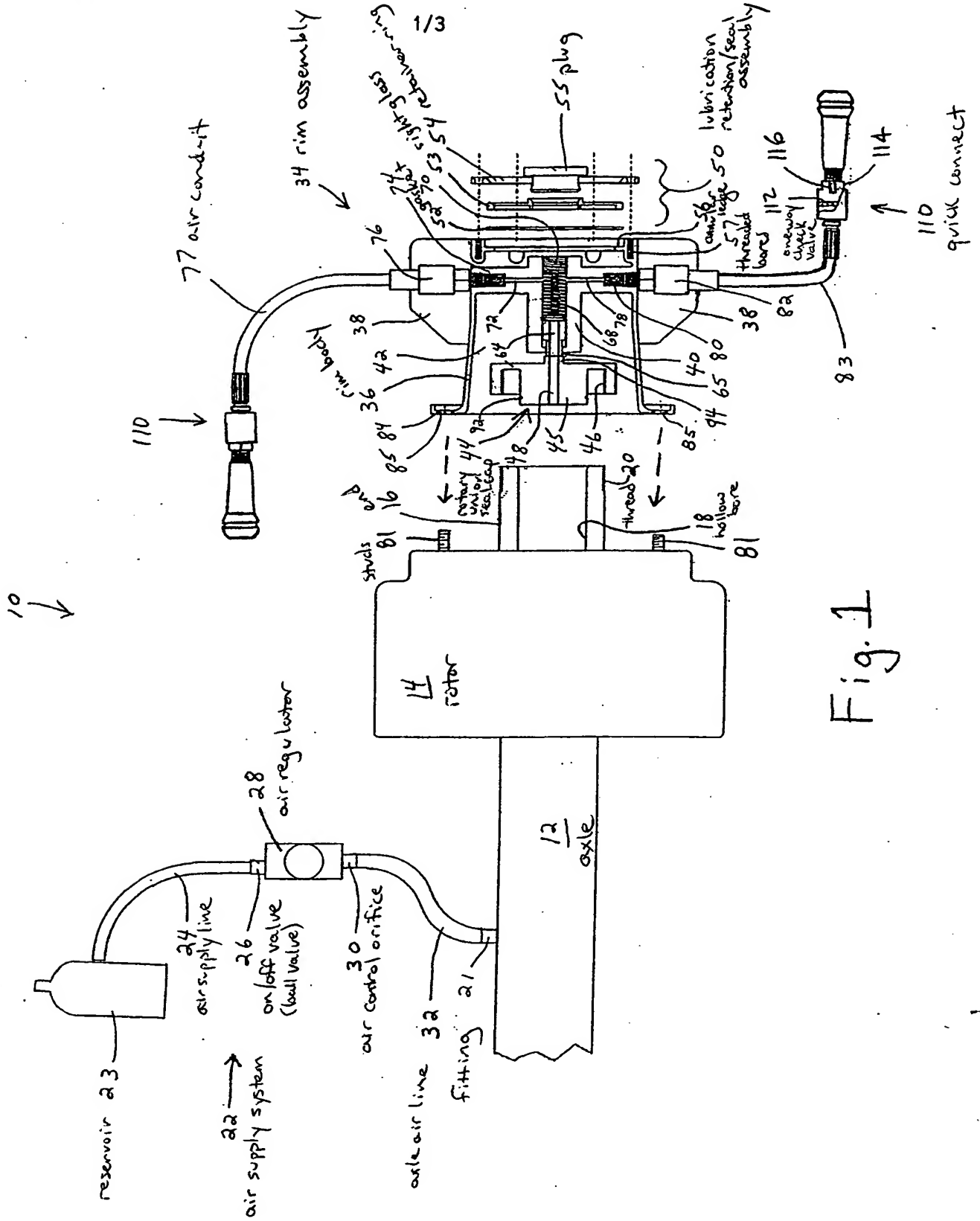


Fig. 1

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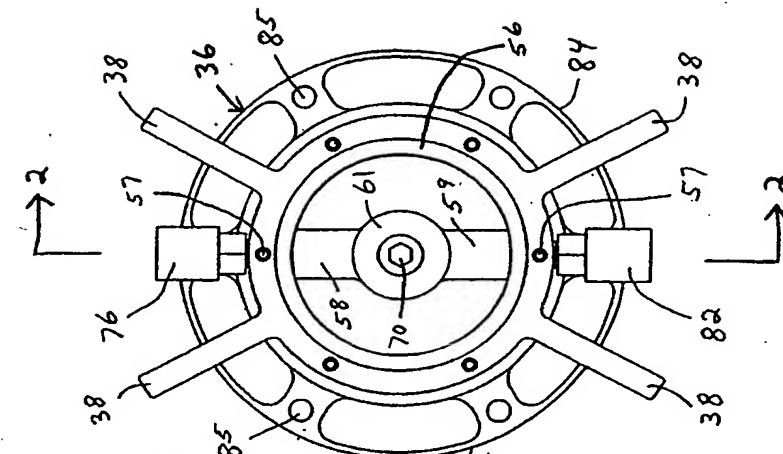


Fig. 3

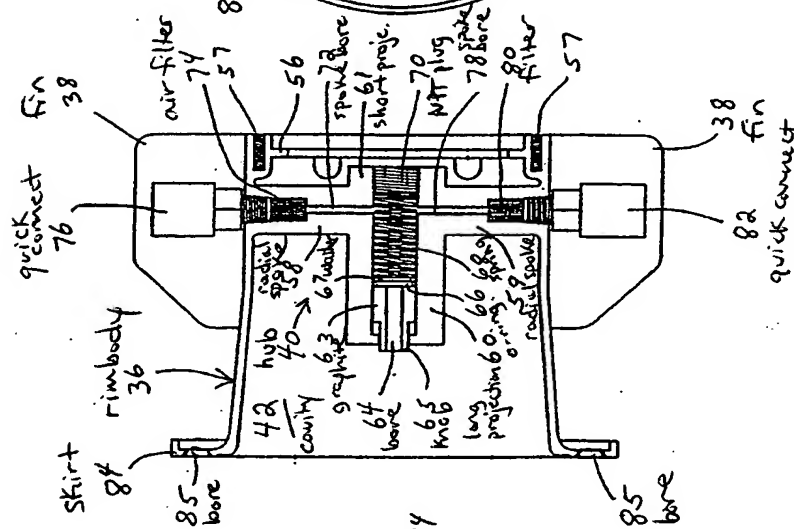


Fig. 2

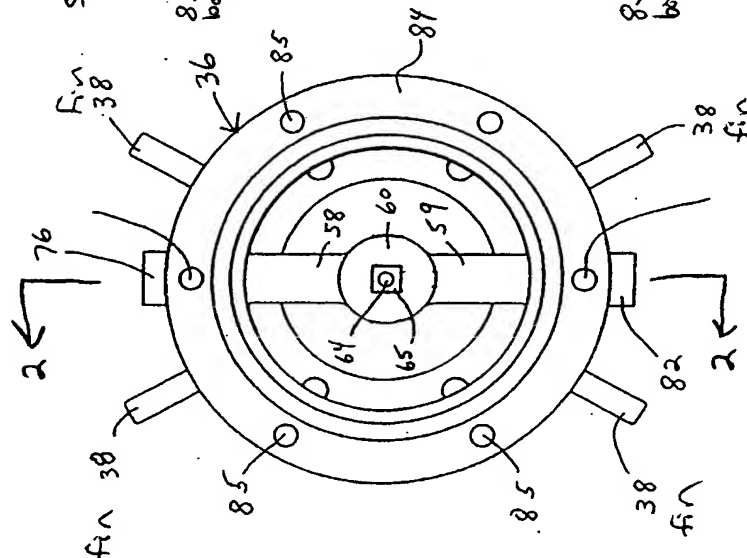


Fig. 4

